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(54) Communicating Thermostat

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Notice: This application is as filed and may therefore contain an incomplete specification.

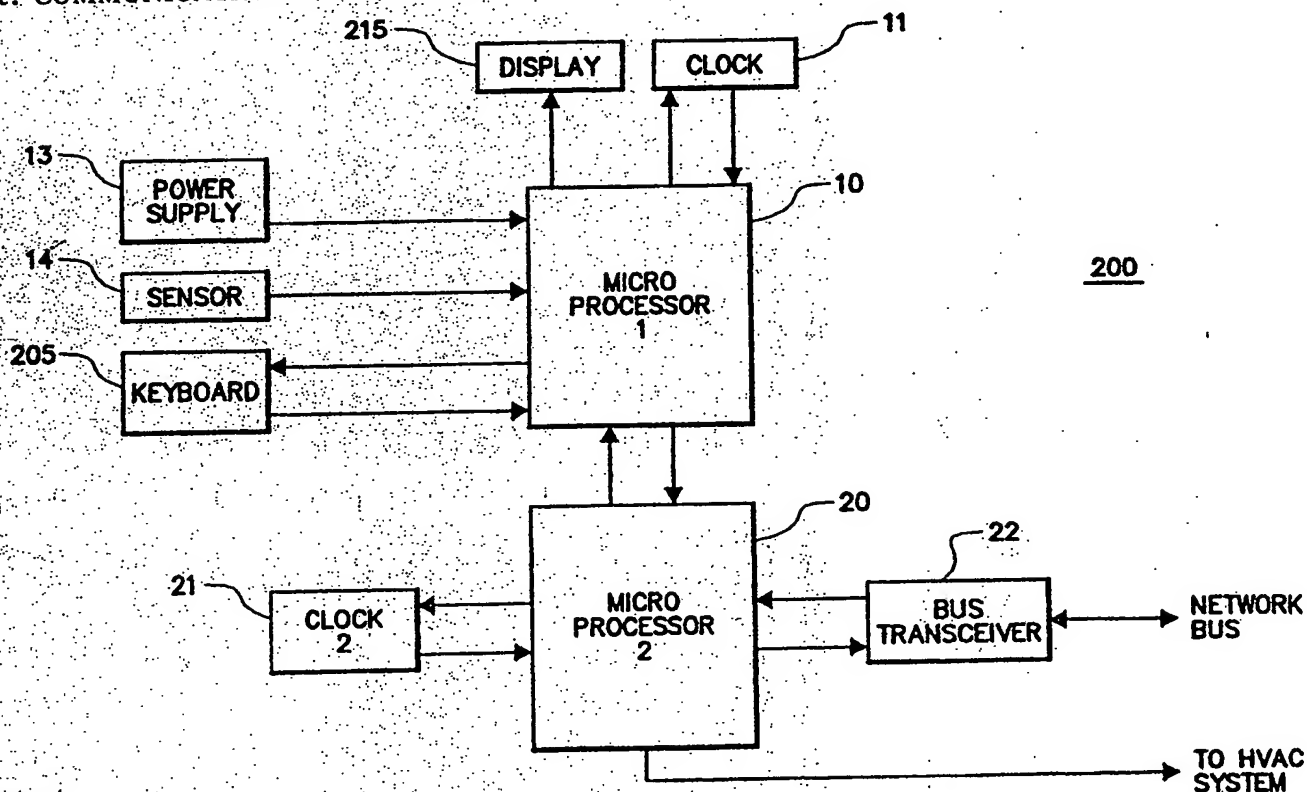




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## (54) Title: COMMUNICATING THERMOSTAT



## (57) Abstract

A thermostat providing external communication comprising two microprocessors. One microprocessor may be dedicated to the external communication while the other microprocessor runs the application programming. The thermostat is separated into a thermostat housing and subbase. One microprocessor may be located within the thermostat housing with the other located within the subbase. This allows for changing the applications programming through replacement either the housing or the sub-

COMMUNICATING THERMOSTATBACKGROUND OF THE INVENTION

The present invention is directed to the field of thermostats and more particularly relates to thermostats having the ability to communicate externally.

Thermostats are well known devices for controlling temperature within a selected space or grouping of spaces. Microprocessor based thermostats are now widely available as reliable devices for achieving temperature control.

Typically, an operator could enter a series of times and temperatures for controlling selected space or grouping of spaces through a particular temperature according to the schedule desired by the operator. Thereafter, the thermostat would automatically control the space or grouping of spaces temperature according to the schedule entered by the operator.

One problem associated with this kind of a thermostat was that the operator had to be physically located at the thermostat in order to make changes to the time or temperature data. If for example it was desired to change the temperature in the middle of the night, it was inconvenient to get out of bed and go to the thermostat to change the temperature.

Another problem was that as advancements were made to thermostat technology, old thermostats became obsolete. It would be beneficial if microprocessor

based thermostats could be modified without a complete changeout of thermostat equipment.

#### SUMMARY OF THE INVENTION

5 The present invention is a communicating thermostat which has two microprocessors. The first microprocessor is connected to the temperature sensor, a data entry means and a display and basically operates as an interface between an operator and the thermostat. A second microprocessor is connected to  
10 the HVAC system to be controlled and to a network bus through a bus transceiver. The second microprocessor does the actual control HVAC system through use of energy management programming and time and temperature scheduling. The bus transceiver is connectable to a  
15 network bus so that the thermostat unit is capable of receiving instructions from an external controller also connected to the network bus. The external controller is capable of changing the time and temperature data stored in the thermostat.

20 In one preferred embodiment, one microprocessor is located in a subbase of the thermostat while another microprocessor is located in the thermostat housing. In this way by merely changing the thermostat housing, a new set of functions can be  
25 installed in a given HVAC system.

#### BRIEF DESCRIPTION OF THE DRAWING

Figure 1 is a block diagram of the inventive thermostat unit.

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Figure 1A shows how the thermostat unit fits into a home automation system.

Figure 2 shows a physical representation of an exemplary thermostat.

5           Figures 3A, 3B, 3C and 3D all show possible physical locations of the first and second microprocessors.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

10           Figure 1 is a block diagram of the presently inventive thermostat 200. The term thermostat unit as used herein refers to part physically located both on thermostat housing 201 and subbase 202. When the thermostat housing and subbase are combined, they form a thermostat.

15           Thermostat unit 200 in a preferred embodiment includes first microprocessor 10, first clock 11, display means 12, power supply 13, sensor 14, keyboard 15, second microprocessor 20, second clock 21 and bus transceiver 22. The interrelationship of these parts will now be described.

20           First microprocessor 10 acts essentially as a man-machine interface for use by the operator to enter data into the thermostat unit. Data entry means 15, in this case a keyboard, is provided so that time and temperature data may be entered into the thermostat so that the thermostat may control operation of the HVAC system according to a preselected schedule. In addition, keyboard 15 may allow an operator to

25

provide already entered time and temperature

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data. First microprocessor 10 includes memory for storage of time and temperature data.

Sensor 14 senses local air temperature, and produces a temperature signal representative of local air temperature. The temperature sensor may be, for example a thermistor. First microprocessor 10 receives the temperature signal and provides the temperature signal to display 12 for displaying of local temperature. The temperature signal is also sent to the second microprocessor 20. More on second microprocessor's 20 use of the temperature signal is described hereinbelow. Power supply 13 provides power to first microprocessor 10. As an example, power supply 13 may be a battery.

Display 12, may provide information such as, time, current temperature set point, scheduling information, and whether or not the thermostat operation has been overridden by an external portion of the system.

First clock 11 provides the first microprocessor 10 an accurate time base for use in communication with the display, power supply, sensor, keyboard and second microprocessor. Clock 11 may be a crystal oscillator.

Second microprocessor 20 serves two primary functions. First, second microprocessor 20 stores in a memory (not shown) energy management programs which allow the thermostat unit to efficiently operate the HVAC system. For two examples of stored temperature

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directed to United States patents 4,395,847 issued to  
Levine on June 22, 1982 and 4,606,401 issued to Levine  
et al. on August 19, 1986, both of which are  
incorporated herein by reference.

5           Secondly, second microprocessor 20 controls  
communications between the thermostat unit and other  
network units connected the network bus.

10           Bus transceiver 22 converts network bus signals  
into signals which can be received and executed by the  
second microprocessor 20. Second clock 21 is  
connected to the second microprocessor 20 to provide  
an accurate time base upon which communications  
between the first microprocessor and the second  
microprocessor can occur. Communications between the  
15           first and second microprocessors occurs using a  
communications protocol. One preferred protocol is  
the protocol disclosed in copending United States  
patent application serial No. 07/811,491 entitled  
Communication Method and Apparatus by Steven C.  
20           Nichols which is commonly assigned with the present  
application. This protocol is merely exemplary, and  
in no way is limiting to the present invention. The  
present invention could be equally as well used in RF,  
infrared or fiber optic communication schemes as  
25           examples.

Figure 1A shows how the thermostat fits into a  
home automation system. The thermostat may be  
connected to a security alarm system 1000, lighting  
control system 500 and appliances control system 600



to provide a single control system for many electrical loads within a building. Each system may include a control panel, one of which may be a master control. The various systems communicate through use of a common protocol such as the protocol disclosed in copending U.S. patent application serial no. 07/811,772 entitled DC BALANCED 4B/8B BINARY BLOCK CODE FOR DIGITAL DATA COMMUNICATIONS by Meyers which is commonly assigned with the present application.

Figure 2 shows physical construction of the thermostat unit of the present invention. Thermostat 200 is made up of thermostat housing 201 and subbase 202.

Temperature sensor 214, display means 215 and data entry means 205 are physically located in the thermostat housing 201. Data entry means 205 in this case is a keyboard comprising keys 206 through 211. The keys can be used to input data into the thermostat in a method well known in the art.

Turning now to Figures 3A, 3B 3C and 3D, there shown are four possible configurations of locations for the first and second microprocessors 10 and 20. In Figure 3A, first microprocessor 10 is located in the thermostat with keyboard 205, temperature sensor 14 and display 215. In Figure 3B, both microprocessors are located in subbase 202 while the keyboard display and temperature remain in the thermostat 201. In Figure 3C, both microprocessors are located in the thermostat along with the

temperature sensor display and keyboard. Figure 3D,  
the first microprocessor is located in the subbase while  
the second microprocessor is located in the thermostat  
housing.

5 Separation of the thermostat unit into the thermostat  
housing and subbase provides a number of advantages.  
First, placement of the thermostat without replacement of  
the subbase saves a large amount of time. Separation of  
the two microprocessors with at least one microprocessor  
10 being located in the subbase allows a new thermostat  
housing having a new microprocessor and new functions to  
be added to the subbase without the attendant cost of  
complete replacement of the thermostat. Therefore, with  
future advances in the thermostat art, a new thermostat  
15 housing could be hung on an old subbase and provide new  
functionality without the cost of completely replacing a  
thermostat.

U.S. Patent No. 4,921,163 and UK patent application  
no. GB 2,212,949A both show two processor computer control  
20 systems which could be used for HVAC controls, but both  
approach the problem in a larger way and are not concerned  
with tying into total home control systems.

1. A thermostat for control of a Heating Ventilating and Air Conditioning system (HVAC system) wherein the thermostat has a clock data generator means and is divided into a thermostat housing(201) and a wall-mounted thermostat subbase(202),

5 said housing having data entry means(205) for entering time and temperature data by the operator, and a temperature sensor(14), the output of each of which are accessible in some form by a first microprocessor(10) in  
10 said housing, characterized in that said housing has mounted therein a small panel display means(215) for display of time and temperature data,

further characterized in that a second microprocessor is contained in said subbase and in communicative  
15 connection to receive control instructions from said first microprocessor and which controls the HVAC system directly.

2. The thermostat of claim 1 further characterized in  
20 that a bus transceiver (22) is connected to said second microprocessor, said transceiver being connectable to a network bus for communication with a home automation system.

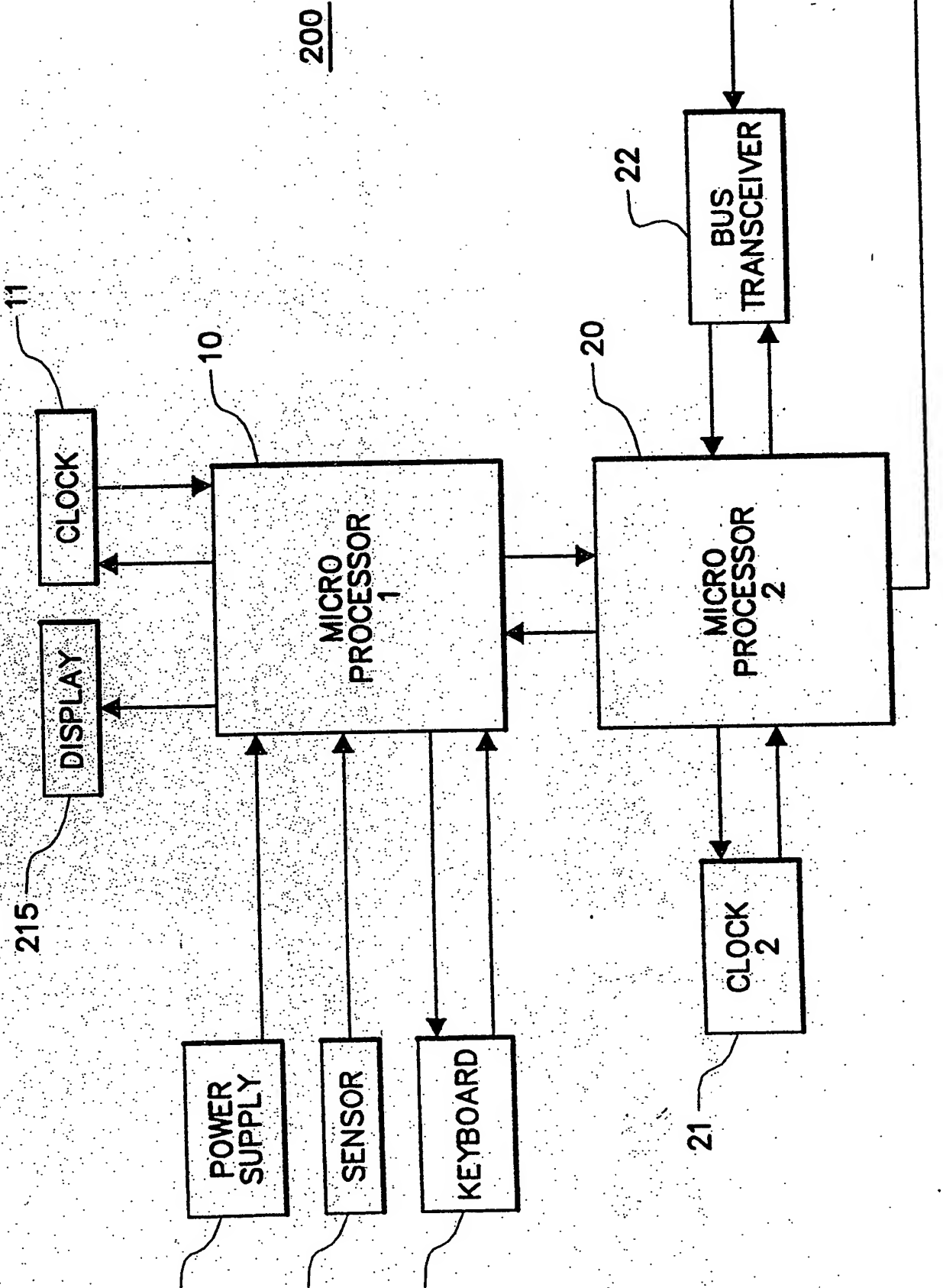
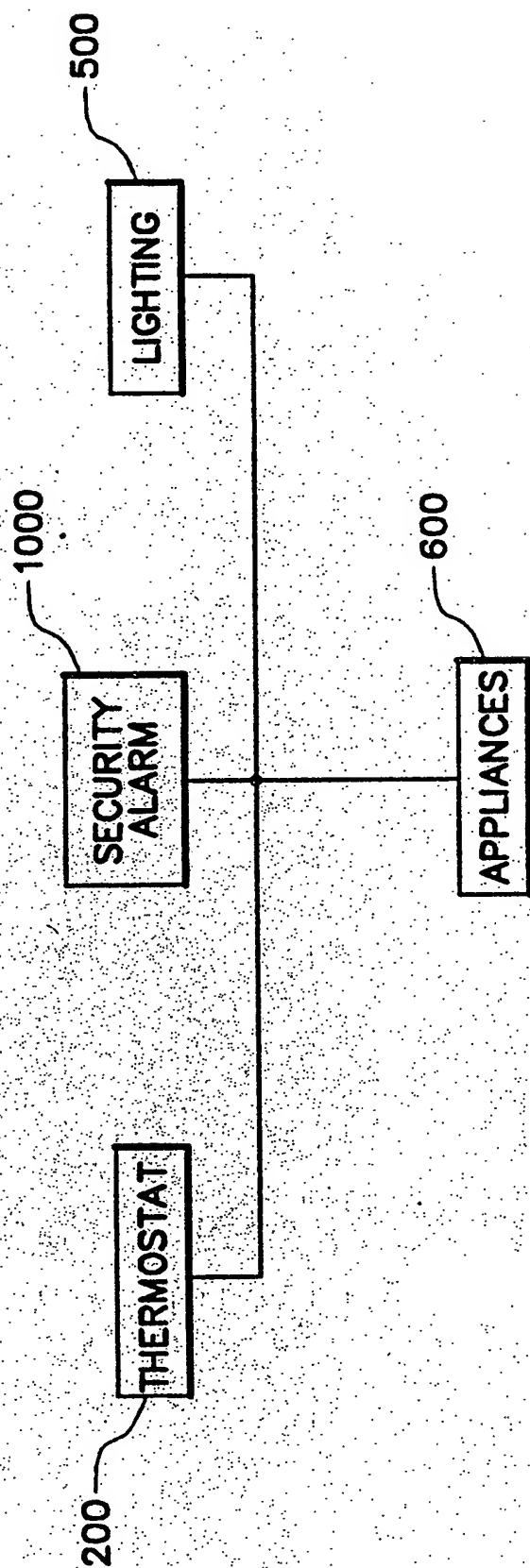


Fig. 1

*Fig. 1a*

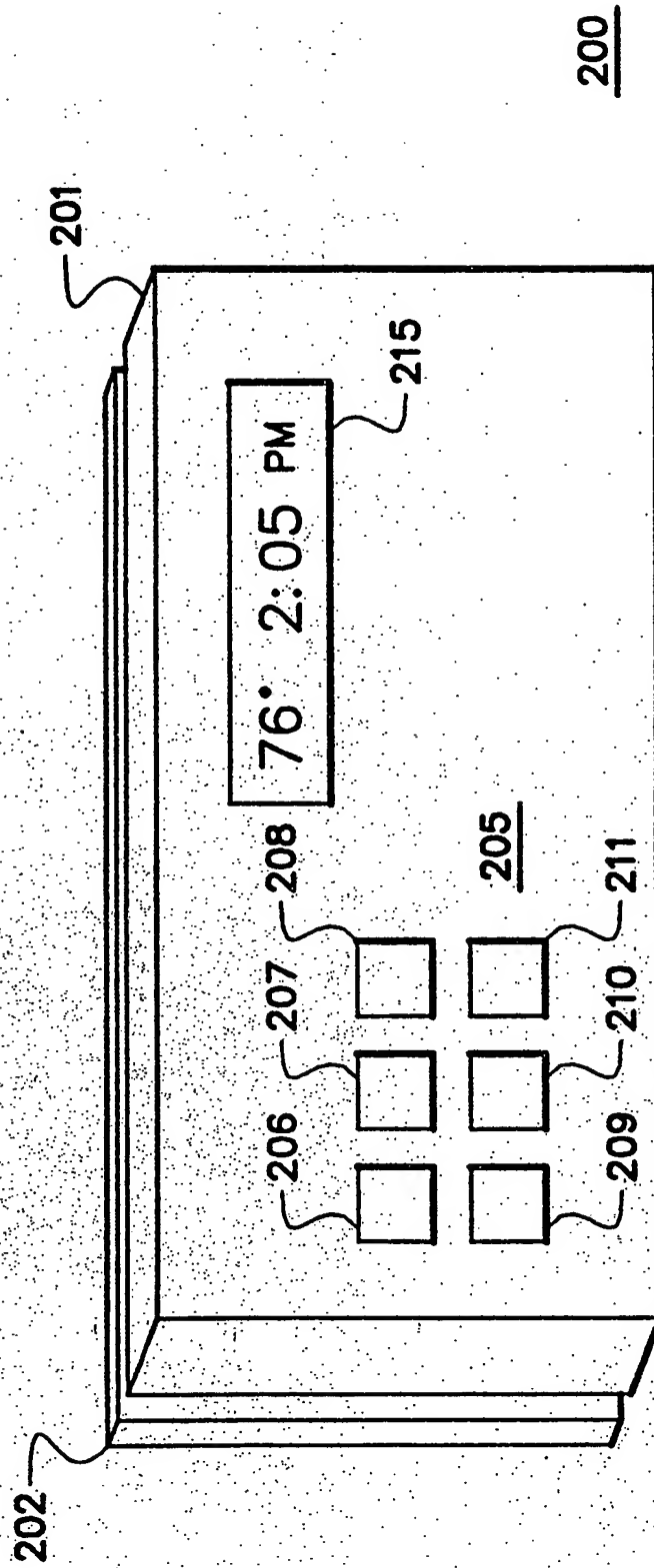
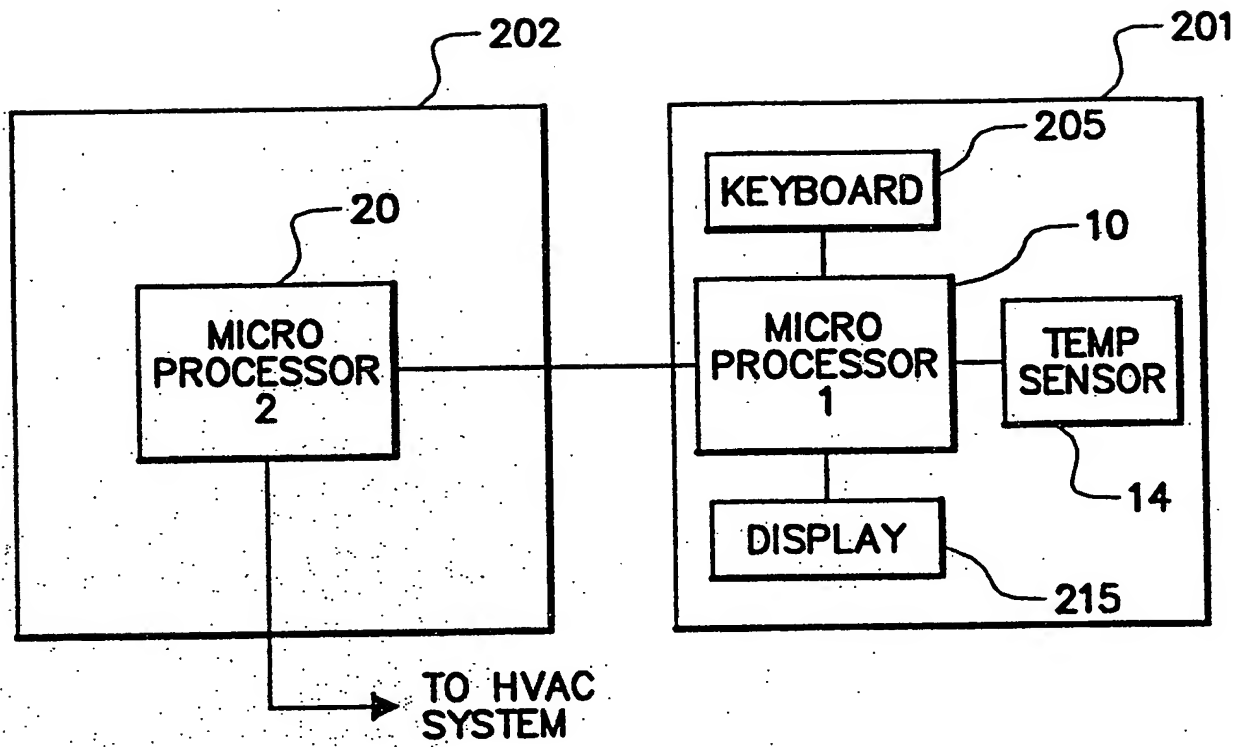
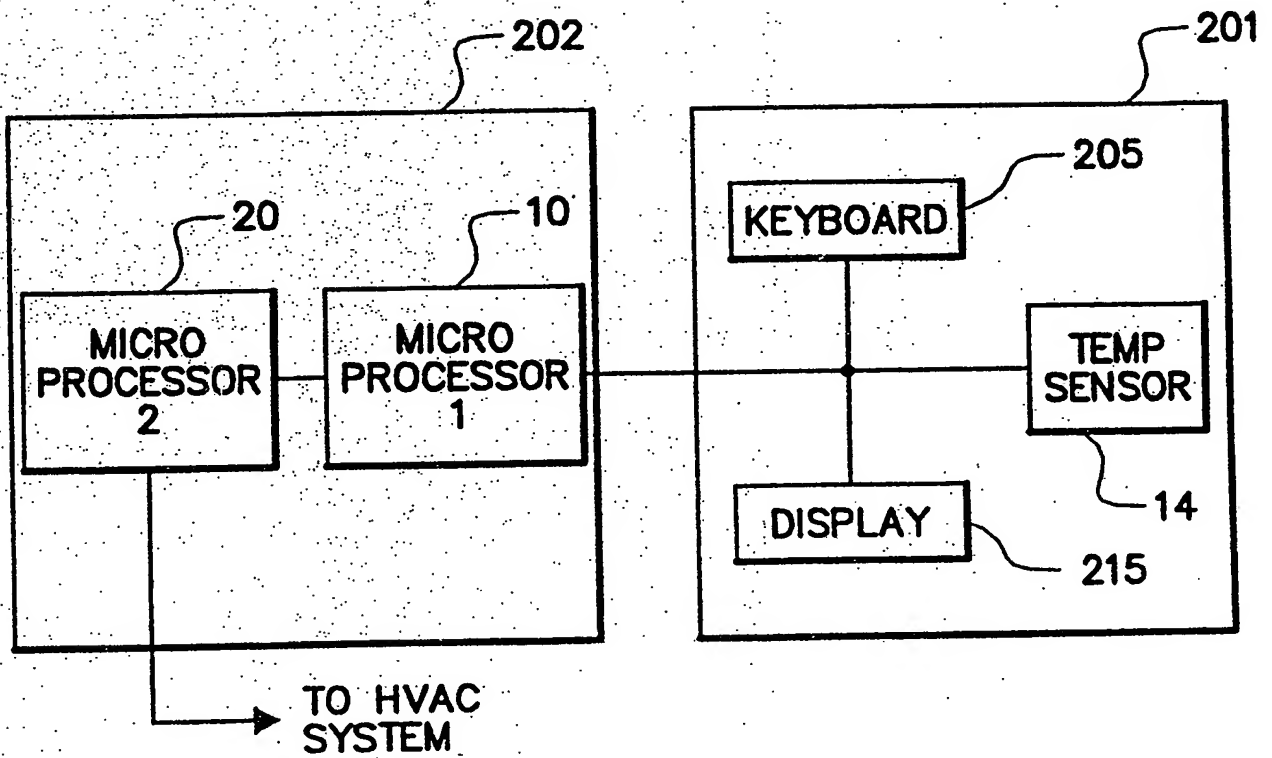


Fig. 2

*Fig. 3a**Fig. 3b*

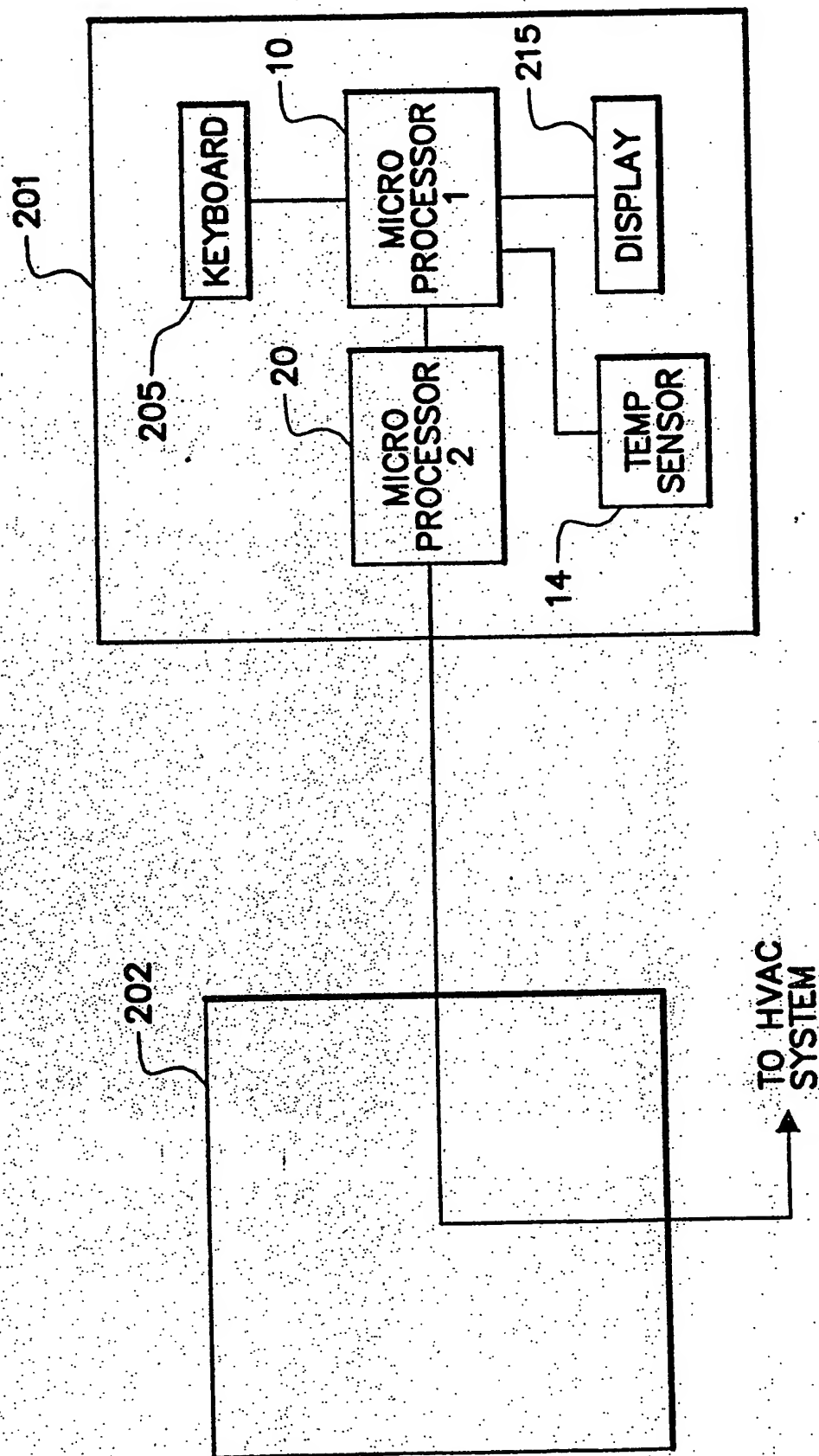


Fig. 3c



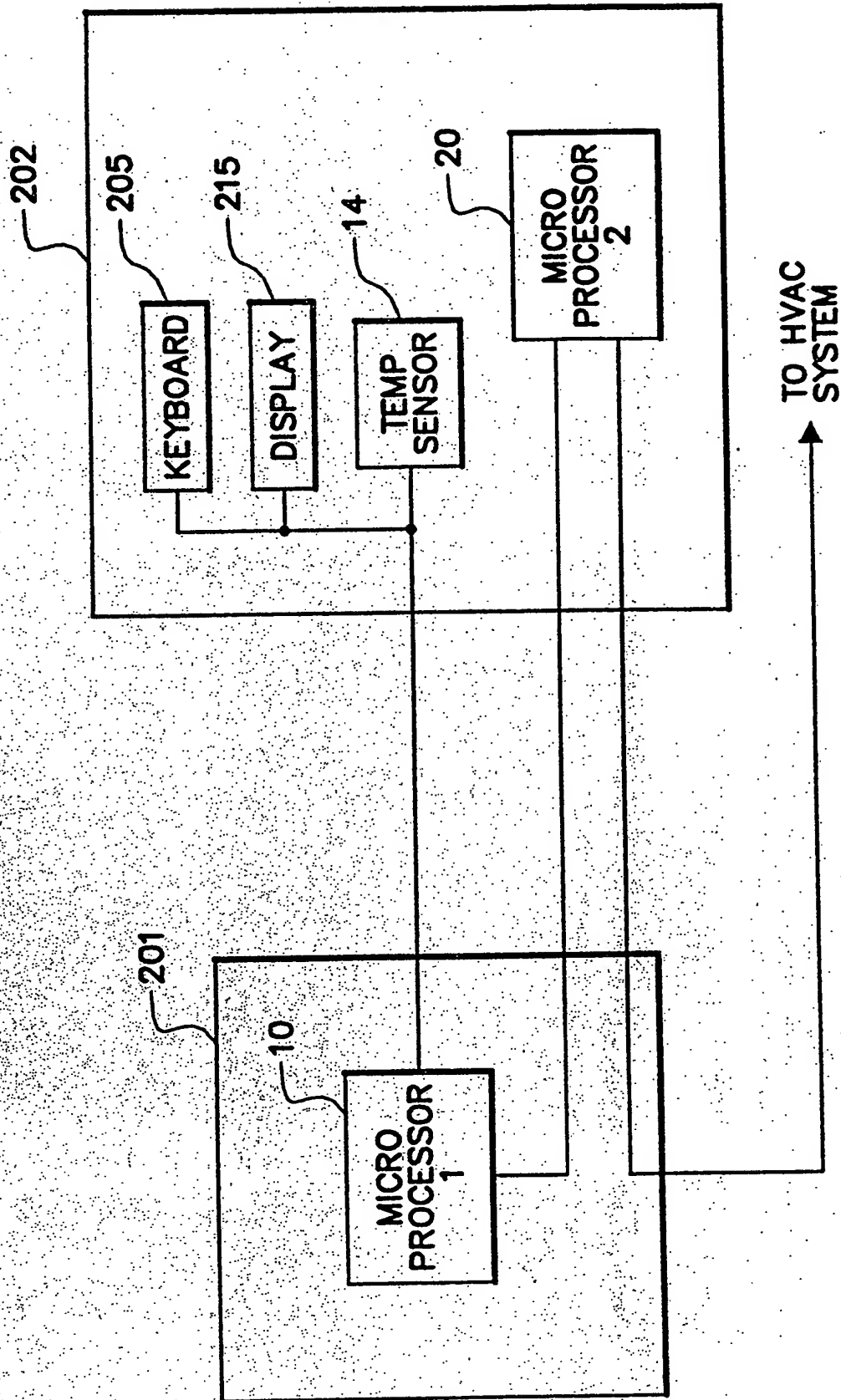


Fig. 3d